IIT KHARAGPUR

NPTEL ONLINE CERTIFICATION COURSES

NPTEL

# FOUNDATION ENGINEERING

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## Lecture 01: Introduction-I

# Detailed course plan

- Week 1 : Introduction, Soil Exploration
- Week 2 : Penetration Tests, Geophysical Exploration
- Week 3 : Bearing Capacity  of Shallow Foundations
- Week 4: Settlement of Shallow Foundation
- Week 5 : Design of Shallow Foundations

- Week 6 : Deep Foundation, Load Transfer Mechanism in Piles, Pile Capacity
  Pile Load Test
- Week 7 : Pile Group Capacity, Settlement of Pile, Design of Pile Foundation
- Week 8 : Lateral Earth Pressure- I
- Week 9 : Lateral Earth Pressure- II
- Week 10 : Earth Retaining Structures
- Week 11: Sheet Piles and Braced Excavation
- Week 12: Soil Arching, Underground Conduits

# List of Reference materials and Books


- Arora, K.R., “Soil Mechanics and Foundation Engineering.” Standard Publisher, New Delhi.
- Purnmia, B.C., “Soil Mechanics and Foundation Engineering.” Laxmi Publication.
- Ranjan, G. , Rao, A. S. R., “Basics and Applied Soil Mechanics”, New Age International,2007.
- Braja M. Das, “Principles of Foundation Engineering.” PWS Publishing, USA. 1999
- Bowles, J.E., 1997. Foundation Analysis and Design, fifth ed. McGraw-Hill, Singapore.

The design of foundations generally requires a knowledge of factors as:

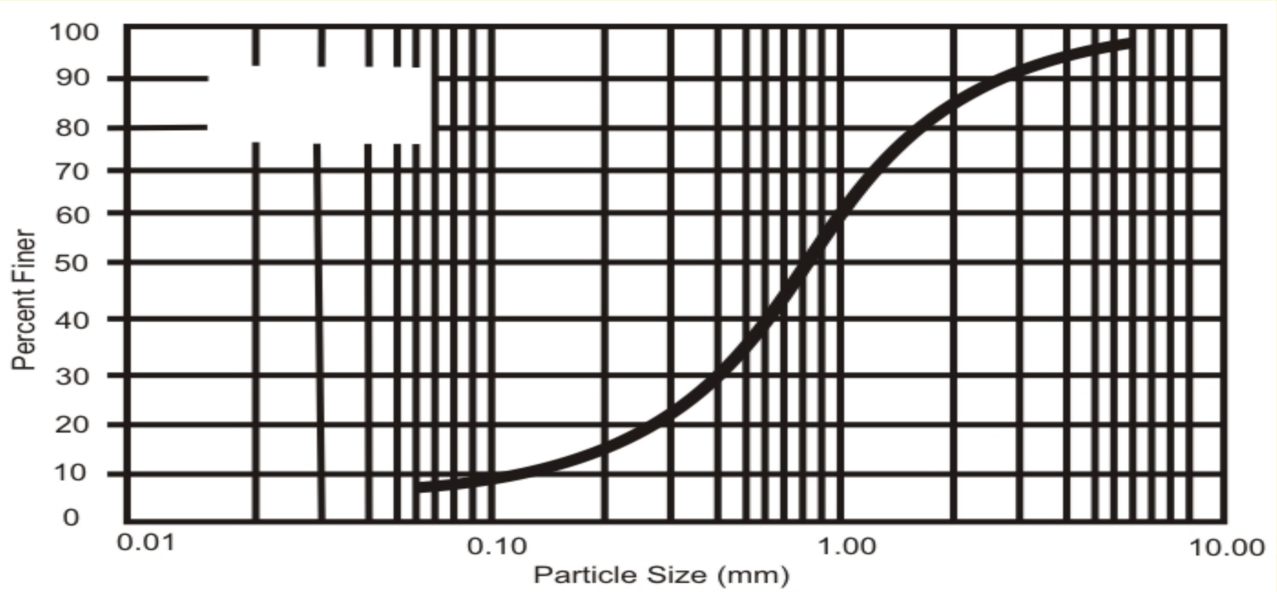
- The load that is coming on the foundation
- The requirements of the local building code
- The behavior of soil that will support the foundation system
- The geological condition of the soil

<u>Geotechnical Properties of Soil</u>

- **Grain-Size Distribution**

**Generally determined by**

- ❖ **Sieve analysis for coarse-grained soil**
- ❖ **Hydrometer analysis for fine-grained soil**




<u>For coarse-grained soil</u>

Uniformity coefficient ($C_u$)

$$C_u = \frac{D_{60}}{D_{10}}$$

Coefficient of Curvature ($C_c$)

$$C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}}$$

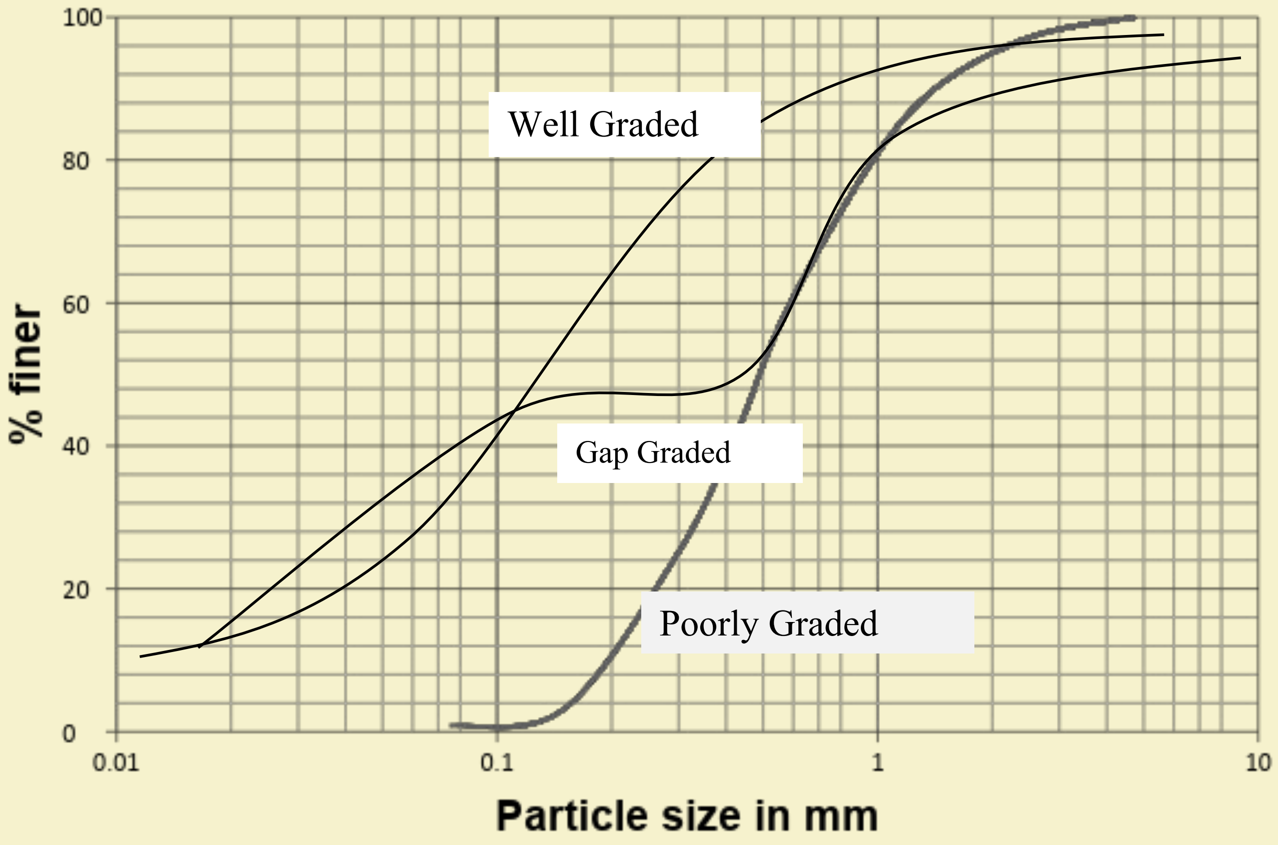
- Well-graded soil

$C_u > 6$ for sands
$> 4$ for gravels

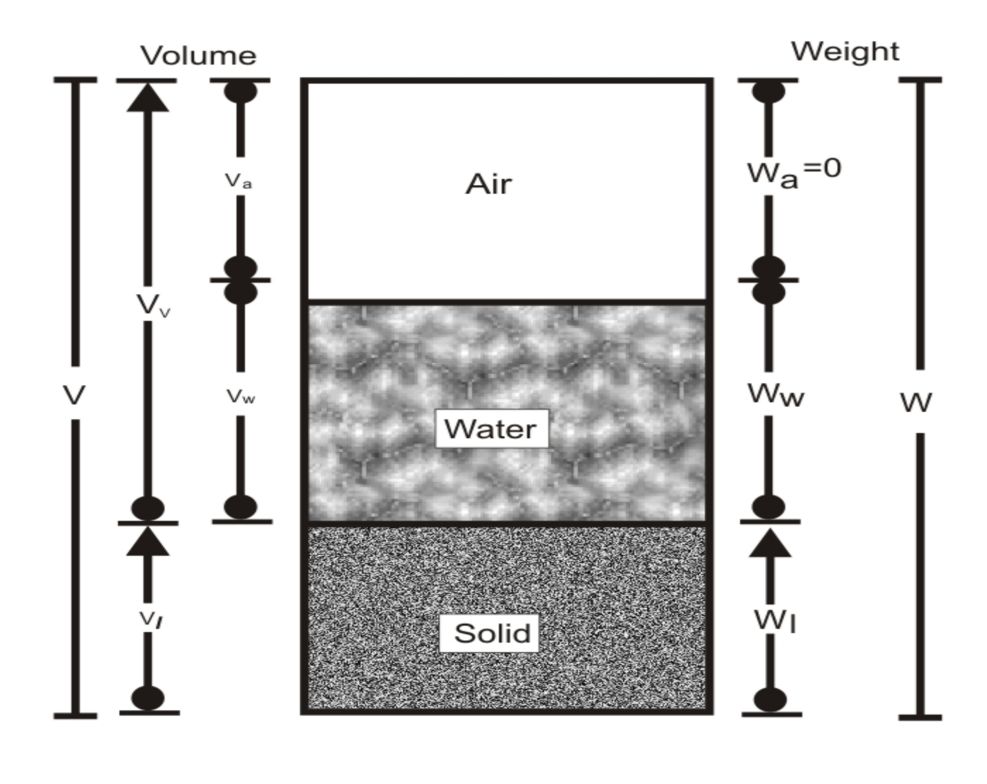
and $C_c$ must lie between 1 and 3

- Poorly-graded soil

- Gap graded soil



## Weight-Volume Relationship




- Void ratio $e = \frac{V_v}{V_s}$
- Porosity $n = \frac{V_v}{V}$
- Degree of saturation $S(\%) = \frac{V_w}{Vv} \times 100$
- Moisture content $w(\%) = \frac{W_w}{Ws} \times 100$

$$Se = G_s w$$

Specific gravity of solids ($G_s$) is defined as the ratio of the weight of a given volume of solids to the weight of an equivalent volume of water at 4°C.

The unit weight of the soil at any water content or any degree of saturation can de written as:

$$\gamma_{bulk} = \frac{(G_s + Se)\gamma_w}{1+e}$$

where $G_s$ is the specific gravity of the soil, $\gamma_w$ is the unit weight of the water (9.81 kN/m$^3$ ≈ 10 kN/m$^3$). Specific gravity of solids ($G_s$) is defined as the ratio of the weight of a given volume of solids to the weight of an equivalent volume of water at 4°C.

$$\gamma_{dry} = \frac{G_s \gamma_w}{1+e}$$ (in case of dry soil S = 0)

$$\gamma_{dry} = \frac{\gamma_{bulk}}{1+w}$$

$$\gamma_{sat} = \frac{(G_s + e)\gamma_w}{1+e}$$ (in case of Saturated soil S = 1)